

**FEDERAL AID
ANNUAL RESEARCH PERFORMANCE REPORT**

ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF WILDLIFE CONSERVATION
PO Box 25526
Juneau, AK 99802-5526

PROJECT TITLE: Population dynamics of moose in Alaska: Effects of nutrition, predation, and harvest

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FEDERAL AID GRANT PROGRAM: Wildlife Restoration

GRANT AND SEGMENT NR: W-33-3

PROJECT NR: 1.57

WORK LOCATION: Game Management Unit 20A

STATE: Alaska

PERIOD: 1 July 2004–30 June 2005

I. PROGRESS ON PROJECT OBJECTIVES SINCE PROJECT INCEPTION

OBJECTIVE 1: Review literature on moose biology, indices of nutritional status, ungulate population models, predator–prey relationships, and harvest data.

We continue to review available scientific literature using Internet searches.

OBJECTIVE 2: Estimate and evaluate the usefulness of several reproductive and condition indices for moose in Unit 20A and investigate the influence of weather on these parameters.

We drafted a paper entitled “Detecting relative resource limitation in Interior Alaska moose populations” that summarizes 10 years of data from our study area and documents comparable data from other Interior moose populations. The indices that are contrasted include first age of reproduction and older pregnancy rates, first age of twinning and twinning rates by age and population, proportion of calves in the immediate postcalving population, winter calf weights, proportion of available browse removed over winter, and proportion of browsed plants that were broomed or broken.

We documented a continued 10% decline in the expected proportion of calves in the immediate postcalving population. To derive an expected proportion of calves in a postcalving moose population, we used a value measured in a low-density moose population in Unit 20E where food was not deemed a significant limiting factor to moose. We concluded

Please note: This is a progress report and the information contained within may be further analyzed and refined

that density-dependent nutritional limitation is apparent today in Unit 20A and an expected result of maintaining moose at high density. Predation was equally important in limiting population growth during this study.

An untested hypothesis is whether large-scale adverse weather is needed to initiate a decline in numbers and how productivity responds during such adverse weather. Previously, we have questioned the validity of a long-term carrying capacity because adverse weather has initiated strong declines in moose numbers in the past, and the adverse effects of weather and predation appeared to work in a synergistic fashion to rapidly reduce population size. If adverse weather further reduces productivity, this would be clear evidence that weather-induced resource limitation is a strong secondary influence on moose populations, at least at the current high density. If adverse weather acts in a density-independent fashion to reduce high- and low-density moose populations as per conventional wisdom, then high-density populations should be left with more moose following adverse weather compared with low-density populations. This would be a potential benefit of managing moose at high densities, in addition to the consumptive and nonconsumptive benefits.

Winter snow conditions were unfavorable during this reporting period, compared with the previous 9 years of study, but a significant decline in the population in 2005 is not predicted based on mortality and natality rates. The greatest response to adverse weather during this 10-year study was the low natality in 2001 following the relatively short prior summer of 2000. The short summer of 2000 had relatively few snow-free days and was relatively cool with a relatively low number of growing degree days. Since 2001 we have seen reduced natality in 2003 and 2005. In 2003 we hypothesized that this alternate-year effect is a lingering response to the short summer of 2000. For example, we observed the lowest parturition rate for cows 4 years and older in 2001 (63% of 68 cows ≥ 4 years old gave birth). By not giving birth in 2001, cows apparently recovered well and in 2002 produced the highest parturition rates observed during 1996–2002 (87.5% of 80 cows ≥ 4 years old gave birth). Our hypothesis is that this elevated productivity stressed the cows because in 2003 we again observed the identical low parturition rate (63% of 93 cows ≥ 4 years old gave birth) observed in 2001. To test this hypothesis we predicted a high rate in 2004 and a reduced rate again in 2005, assuming no additional adverse summer weather. As predicted, we observed a high pregnancy rate in 2004; 89% of 104 cows ≥ 4 years old gave birth. This is the highest pregnancy rate observed to date since studies began in Unit 20A in 1996. In 2005 we confirmed a low parturition rate (66% of 98 cows ≥ 4 years old gave birth).

Since 1996 we have observed a parturition rate of only 67% ($n = 791$) and a twinning rate of only 8% ($n = 527$) for radiocollared moose ≥ 3 years old. Strong age-specific indicators of nutritional stress were even more noteworthy: 1) No 24-month-old moose ($n = 38$) were pregnant, 2) only 28% of 151 thirty-six-month-old moose were observed parturient, and 3) no observed moose less than 60 months old produced viable twins. We documented a minimum 20% decline in production with a 3.2-fold increase in density since 1978. However, the substantial increase in moose numbers has allowed far greater sustainable yields than would have been possible at the lower density.

Transrectal ultrasonography and PSPB analyses produced identical results in 1996, the only year in which both results were available. However, daily observations during the calving

seasons indicate lower actual productivity in the population and less variability than indicated using ultrasound or PSPB. We use observed parturition rates as the best indicators of production in the population because they are most meaningful to the population and because of the increased likelihood of neonatal or intrauterine mortality in this high-density population.

Management staff have flown spring twinning rate transect surveys in central portions of the Tanana Flats for several decades without the use of radiocollared moose. Because these surveys more readily sampled moose from all age classes each year, these surveys more accurately estimated annual twinning rates in the population compared with our sampling, which is biased by young age classes during most years. To further investigate the accuracy of twinning rate transect surveys, we tested whether differences in twinning rates could be observed with a helicopter versus a fixed-wing aircraft and found no significant differences.

Weighing short yearling moose appears to be a particularly useful and relatively inexpensive tool for evaluating moose population condition. For example, we noted substantial differences between weights in the adjacent Denali and Unit 20A populations. We also noted significant differences in weights between subpopulations within the study area. Short yearlings weighed in the Tanana Flats have weighed significantly less (about 17 kg less on average) than those in the Alaska Range foothills every year that sampling was robust. Although virtually all calves are born in the Tanana Flats, calves that move to the Alaska Range foothills in summer or autumn must have an improved energy balance relative to those remaining in the Tanana Flats. Because of the reduced moose body weights in the Tanana Flats, we have assigned the Tanana Flats a higher priority for improving moose habitat compared to the Alaska Range foothills.

We expected birth weights to provide a relatively sensitive index to winter and spring maternal and range condition and that elevated birth weights would occur among the Alaska Range foothills subpopulation, in part because short yearlings weighed significantly more in the Alaska Range foothills. However, birth weights may provide only a nonsensitive index to winter and spring conditions. For example, we found no significant differences in newborn singleton or twin birth weights with regard to dam collaring location or capture year. As expected, newborn weights in Unit 20A are relatively low compared with those from the Yukon Flats, where moose density is 85% lower and the observed twinning rate (63%) indicates a high nutritional status during ovulation. Our unique finding of a significant difference in birth weights between singleton male and female moose calves may be an indication of the relatively poor nutritional status of moose in Unit 20A.

Depth of rump fat is an index to the condition of individual moose, and potentially an index to relative condition of a moose population. We initially hoped to contrast annual differences in rump fat depths among young moose, e.g., moose in the 10- and 22-month-old cohorts, to provide a tool to evaluate annual differences in moose condition. However, we detected no rump fat among moose in these cohorts. This lack of rump fat apparently is a sign of malnutrition at the current high densities, given that some 22-month-old moose have fat in Denali National Park.

Because short yearling body weights differed between the Tanana Flats and the foothills, we expected to find significant differences in adult rump fat depths from these 2 subpopulations. However, we found no significant differences. We conclude that adult rump fat depths are less sensitive indices of nutrient regime compared to short yearling body weights, presumably because rump fat depths were gathered from a sample of adults of all ages and reproductive histories. Perhaps with a greater sample size, rump fat depths could be used to detect significant differences in nutrient regimes in these subpopulations.

We conclude that rump fat depth is a more expensive and, at times, less sensitive index to nutrient regime in moose compared to twinning rates and weights of short yearlings. We did find significant relationships between March rump fat depths and reproductive status of females, but reproductive indices are much less expensive to collect than fat depths.

Mean maximum depth of rump fat was significantly greater among pregnant versus nonpregnant adult cow moose. Mean maximum depth of rump fat was also significantly greater for moose observed parturient versus those never observed with a calf and for dams giving birth to twins versus those with singletons. We also found that the fattest dams produced the heaviest calves and calved earlier than dams with low rump fat.

With the blood obtained from adult female moose in 1996 and 1997, we attempted to identify potential relationships between 22 serum constituents and rump fat depth using multiple regression models. We conclude, at this time, that standard serum constituents are not useful indicators of rump fat reserves in moose. In addition, the acute phase protein haptoglobin was not helpful in distinguishing stressed from nonstressed individuals.

OBJECTIVE 3: Estimate causes and respective rates of mortality among radiocollared moose of various age classes in Unit 20A.

A composite of all mortality of radiocollared moose by age from May 1996 through June 2005 indicates that annual calf survival rate was 53% for both sexes. These data are from 79 newborn calves we collared in May 1996 and 1997 and 279 additional male and female short yearlings we collared during March 1997–2005. We also maintained a representative sample of random adult females throughout this study. Thus, most of the data for older cohorts is female-specific. This is the third reporting period in which we collared significant numbers of male short yearlings. Thus, we are just beginning to assess sex-specific differences in mortality rates.

The annual composite yearling survival rate for females from mid May 1997 through mid May 2005 was 83%. In comparison, the 2-year-old through 5-year-old annual composite rates ranged from 96 to 100%. These rates averaged 94% for ages 6 through 10 years, and declined further to 83% for ages 11 through 16. No moose were known to live to 18 years. In conclusion, female moose appear to be most vigorous and capable of avoiding predation from 2 through 5 years of age.

Wolf predation was the major cause of death among adult and yearling moose. In 38 cases where we were able to investigate the cause of death of radiocollared moose older than 24 months, wolves killed 22 (58%), grizzly bears killed 7 (18%), and 9 (24%) died from factors

other than predation. Of 42 yearlings (12 to 24 months old) that died, wolves killed 29 (69%), bears killed 8 (19%), and 5 (12%) died from other factors.

Hunters took a nominal harvest of cows in the study area during September 1996 through 1998 and 2000 through 2003, but this changed during this reporting period. Cow harvests were <1% of the cow population during the first 4 hunts and increased to between 1 and 2% during the next 2 hunts. During this reporting period, 542 antlerless moose were harvested, which constituted 3.3% of the prehunt population. These were the first legal cow harvests since 1974. Regulations were liberalized in 2002 and further in 2003 through 2005 to encourage harvest of moose other than bulls to reduce population size and because bull:cow ratios had declined below the objective of 30 bulls:100cows.

Simultaneous to encouraging harvest of cows and calves, new regulations were enacted to protect middle-age bulls from hunters. We noted a sharp decline in the number of bulls harvested in 2002. Only 363 bulls were reported harvested in September 2002 compared with an average annual harvest of 589 bulls the previous 7 years (range 526–660 bulls).

Sustainable harvests of moose per unit area remained at the highest level observed in Interior Alaska in recent years, despite moose having the lowest reported birth rates and reduced bull harvests. This occurs because harvest constitutes small proportions of all Interior Alaska moose populations, so harvest density is strongly correlated with moose density. Unit 20A moose density is the highest in Interior Alaska, and therefore has the highest harvest density.

The 1996 and 1997 radiocollared newborn calves experienced the highest annual survival rates (52–56%) observed during 7 Alaska–Yukon comparable studies. High calf survival undoubtedly contributes to the reduced reproductive performance of this population.

Predation was by far the major proximate cause of death in this and all previous moose calf mortality studies. Wolves killed more calves than both bear species in this study, while grizzly bears and black bears killed about equal proportions of calves. In previous moose calf mortality studies, black or grizzly bears were clearly the major predator. In addition to mortality detected using radiocollared calves, mortality prior to birth or neonatal mortality during the first 24 hours after birth apparently occurred in 7 (17%) of 42 pregnancies in 1996 and 3 (13%) of 23 pregnancies in 1997.

OBJECTIVE 4: Summarize existing statewide reproduction and population data for moose.

Currently, there is a need for a single consolidated source for past moose survey information as well as other data collected on condition or reproductive parameters of moose populations within the state.

Work was begun on this objective during this reporting period.

II. SUMMARY OF WORK COMPLETED ON JOBS IDENTIFIED IN ANNUAL PLAN THIS PERIOD

JOB 1: Continue literature review on (1) moose biology and ecology at high densities; (2) indices to nutritional status of ungulates; (3) models of ungulate population dynamics; (4) predator–prey ratios in relation to population dynamics of moose, caribou, sheep, wolves, and

grizzly bears; (5) predator/prey relationships in multi-prey, multi-predator systems; and (6) population and harvest data on moose, caribou, sheep, wolves, and bears in Unit 20A.

I routinely reviewed old and new literature as necessary to remain current on relevant aspects of moose biology. Also, Kalin Kellie completed her master's degree on moose movements during this reporting period, which includes an exhaustive review of the literature. I estimated that 10 person-days were spent on this job during this reporting period.

JOB 2: Estimate and evaluate the usefulness of several reproductive and condition indices for moose in Unit 20A and investigate the influence of weather on these parameters.

There were no capture-related mortalities this reporting period; 51 total moose were captured in early March and April 2005. We recaptured 24 adult females; most were 69-month-old females. We replaced the aging ATS collars that were deployed when these moose were 9 months old. We used blood samples to estimate a pregnancy rate of 76% from PSPB values. We had insufficient funds to measure rump fat depths.

We also radiocollared and weighed 24 male short yearlings and radiocollared 2 male yearlings. As in previous years, capture sites were equally divided between the Tanana Flats and Alaska Range foothills. During the first 5 years of capture, weights were significantly higher in the foothills (sample sizes totaled 40 or more short yearlings, 1996–2000 cohorts). This trend continued in the 2001 cohort, although we reduced sample size to 20 female short yearlings to allow funding for recollaring adults. In the 2002 cohort we split the 20 collars for short yearlings between males and females. During the most recent reporting period (2003 and 2004 cohorts), we focused exclusively on collaring young males to investigate age-specific natural mortality rates. This will change the emphasis from evaluating production and natural mortality rates of female cohorts to estimating natural mortality rates of male cohorts.

Approximately 30 fixed-wing radiotracking flights were flown between mid May and mid June 2005 to observe parturition and twinning rates of 112 radiocollared moose greater than 2 years old. Of 98 cows ≥ 4 -years old, 65 (66%) were observed with newborn calves during alternate day flights. We observed a twinning rate of 5% among the 55 radiocollared cows ≥ 5 -years old. Twinning rates from aerial transect surveys totaled 9% ($n = 54$ cows with calves). The median calving date was 21 May, similar to previous years. Newborn calves were observed from 12 to 28 May. Data on weather patterns will be compiled when available from the National Oceanic and Atmospheric Administration.

JOB 3: Assess causes and rate of mortality among radiocollared moose of various age classes in Unit 20A.

To assess causes and rates of mortality of moose within the study area, all radiocollared moose (approximately 150–170 moose) were tracked at least monthly with fixed-wing aircraft during this reporting period. Flights were most frequent in the summer. In addition, a helicopter (R-22) was deployed to recover collars and investigate causes of death of 31 collared moose.

JOB 4: Write progress reports and publish a final report. Also, incorporate results into appropriate Alaska wildlife planning, discussions, and management activities.

Data collected from this project are being used in Unit 20A moose management reports, advisory committee meetings, Board of Game meetings, discussions with the public regarding harvest opportunities, and discussions with the Department of Natural Resources regarding the need to improve habitat in Unit 20A using burns. During this reporting period, results were also presented at the annual meeting of the Alaska Chapter of The Wildlife Society in Fairbanks in April 2005 and at the annual North American moose conference in Montana in May 2005.

III. ADDITIONAL FEDERAL AID-FUNDED WORK NOT DESCRIBED ABOVE THAT WAS ACCOMPLISHED ON THIS PROJECT DURING THIS SEGMENT PERIOD

No additional work was accomplished.

IV. PUBLICATIONS

We made 2 presentations related to this work at the Alaska Chapter Meeting of The Wildlife Society in April 2005 (see Appendix for abstracts). We also made these 2 presentations in May 2005 at the North American moose conference in Whitefish, Montana and submitted 1 paper for publication in *Alces*.

V. RECOMMENDATIONS FOR THIS PROJECT

As recommended in 2003, we changed the emphasis from females to males when collaring short yearlings. This allowed us to investigate age-specific natural mortality rates of males, as we continue to investigate these rates for older females. No data exists on natural mortality rates of male moose older than calves, and area biologists have frequently requested this information.

VI. APPENDIX

The following paper was presented at (1) the Alaska Chapter meeting of The Wildlife Society at the University of Alaska Fairbanks in April 2005 and (2) the North American Moose conference in Whitefish, Montana in May 2005. This paper was then submitted to *Alces* for publication.

INTENSIVE MANAGEMENT OF MOOSE AT HIGH DENSITY: IMPEDIMENTS, ACHIEVEMENTS, AND RECOMMENDATIONS

DONALD D. YOUNG JR., RODNEY D. BOERTJE, C. TOM SEATON, AND KALIN A. KELLIE
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Abstract: In 1994 the Alaska Legislature passed legislation mandating the Board of Game (BOG) to establish population and harvest goals and seasons for intensive management (IM) of identified big game prey populations. Game Management Unit (GMU) 20A in Interior Alaska was identified by the BOG as an area for IM of moose (*Alces alces*) in 1998. In this paper we review the regulatory and biological events that led up to the current management of moose in GMU 20A. We also review the impediments to effective IM, highlight achievements, and make recommendations to more effectively manage moose intensively. We chose GMU 20A because it is unique in terms of IM due to its high moose density, increasing population that has exceeded the IM population objective, and history of

predator management. We identified the following impediments to carrying-out IM effectively: 1) negative public attitude toward antlerless hunts; 2) maintenance of bull:cow ratios; 3) veto power over antlerless hunts by local citizen advisory committees (AC); 4) access issues, including spatial and temporal distribution of the harvest; 5) social issues including local–nonlocal hunter conflicts, landowner–hunter conflicts; high hunter densities; illegal harvest, and lack of support for prescribed burns; and 6) lack of funding for research programs, management activities, and public education. Despite the impediments, the Alaska Department of Fish and Game (ADF&G) has made significant progress in elevating moose harvests, arresting population growth, and providing additional moose hunting opportunities. To more effectively manage moose intensively, we recommend the elimination of AC veto power over antlerless hunts; greater flexibility by ADF&G to implement and manage antlerless hunts; greater authority by ADF&G to conduct prescribed burns; increased funding for management activities, research programs, and public education; and that managers closely monitor hunting related social issues associated with IM of moose populations.

The following paper was presented at: (1) the Alaska Chapter meeting of The Wildlife Society at the University of Alaska, Fairbanks in April 2005, and (2) the North American Moose conference in Whitefish, Montana in May 2005. This paper is being prepared for publication in the Journal of Wildlife Management.

DETECTING RELATIVE RESOURCE LIMITATION IN ALASKA MOOSE POPULATIONS AND IMPLICATIONS

RODNEY D. BOERTJE, DON YOUNG, MARK KEECH, TOM SEATON, AND KALIN KELLIE
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Abstract: To assess relative resource limitation in moose, we evaluated the use of March calf bodyweights, browse-use indices, age-specific pregnancy rates, twinning rates, morphometric measurements, and rumpfat depths (using ultrasound) during 1996–2005. Study populations included the Tanana Flats resident subpopulation (south of Fairbanks), the adjacent subpopulation in the foothills of the Alaska Range (which migrates to the Tanana Flats for calving), and several other populations throughout Interior Alaska. The Tanana Flats resident moose subpopulation exhibited the most extreme signs of resource limitation found in Interior Alaska. The adjacent foothills subpopulation ranked second in terms of resource limitation in Interior Alaska. March calf bodyweights were the most sensitive indicator of resource limitation, and twinning rates were the second most sensitive indicator of resource limitation. We particularly recommend measuring twinning rates, because twinning rates provide information on both resource limitation and population natality. The foothills subpopulation had significantly higher March calf bodyweights than the flats subpopulation during all 4 years when samples of 20 calves were weighed in each area ($P \leq 0.015$, 2-tailed t -test). Weight differences of 20 kg were measured in the 2 subpopulations in each of the 4 years. The highest average weights were from remote rural populations with low moose densities; these weights averaged 70 kg greater than those measured in the Tanana Flats. Moose in the Tanana Flats and adjacent foothills were at extremely high densities and increasing in numbers during this study, yet calf production was the lowest measured in North American continental, wild moose. These data were used to convince a skeptical hunting public that implementation of large-scale antlerless moose hunts were both timely and prudent. These data can also be used to evaluate relative resource limitation of moose before implementing predator control programs to increase moose numbers.

This abstract is for a master's thesis completed during this reporting period and was funded in part by this study.

SUMMER MOVEMENTS OF FEMALE MOOSE AT HIGH DENSITY

Kalin Kellie

Abstract: I examined factors influencing the summer movements of adult female moose (*Alces alces gigas*) at high density in interior Alaska, USA from 1996 to 2003. First, I tested how the distance moved from 4 to 0 days pre-partum was related to migration, change in cover use, reproductive maturity and individual behavior. Second, I evaluated whether long movements prior to parturition were related to predation on previous neonates. Third, I measured the scale of spatial fidelity exhibited by individuals to areas used in early spring (13–15 May) and areas used for parturition. Lastly, I compared summer movements of adult females during periods of low and high population density.

Net movement of females 4 to 0 days prior to parturition was related to migration and a change in cover use. Movement was not related to reproductive experience, individual behavior, or prior predation of neonates. Pre-partum movements were longest for moose moving from open to dense cover. Individuals displayed higher fidelity to areas used in early spring (13–15 May) than to areas used for parturition. This predictable use of fine-scale areas may facilitate effective management of forage quality in early spring.

VII. PROJECT COSTS FOR THIS SEGMENT PERIOD

Stewardship Investment items purchased: *list any equipment or other items purchased for which the cost of the individual item was \$5,000 or more (include cost)*

None during this reporting period.

Total Costs

FEDERAL AID SHARE \$81,200 + STATE SHARE \$27,100 = TOTAL \$108,300

VIII. PREPARED BY:

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SUBMITTED BY:

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